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Case report

Gas geyser – A cause of fatal domestic carbon monoxide poisoning

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ABSTRACT

Carbon monoxide is responsible for a large number of accidental domestic poisoning and deaths throughout the world. Domestic carbon monoxide poisoning is rarely reported in India and remains an under recognized problem. The diagnosis of carbon monoxide poisoning is usually based on autopsy findings, circumstantial evidence and estimation of carboxy-haemoglobin in blood. We report a case of fatal accidental carbon monoxide poisoning in a bathroom where an LPG gas water heater was installed recently. Cherry pink discolouration of the body and organs on autopsy suggested carbon monoxide poisoning. Laboratory analysis of blood by UV visible spectrophotometry revealed presence of dangerous levels of carboxy-haemoglobin. Effective preventive measures can help in bringing down the mortality and morbidity associated with carbon monoxide poisoning.

1. Introduction

Carbon Monoxide (CO) is a common constituent of home and work environments and is regarded as a 'silent killer'.[1] Undetected or unsuspected carbon monoxide exposure can result in accidental deaths. Carbon monoxide is found naturally in the body as a byproduct of heme degradation, it does not reach toxic concentrations unless inhaled from exogenous sources. Carbon monoxide is one of the leading causes of poisoning morbidity and mortality in the Western world. More than half of accidental Carbon monoxide poisoning deaths are caused by motor vehicle exhaust in the USA followed by domestic gas appliances.[2,3] Each year in Britain about 50 people die and 200 are severely injured by Carbon monoxide poisoning and as many as 25,000 people suffer from symptoms of Carbon monoxide poisoning due to faulty gas appliances.[4]

In India the incidence of carbon monoxide poisoning is remarkably low. A careful medline and google search revealed a few reports on fatal carbon monoxide poisoning due to motor vehicle exhaust in India.[5–8] Accidental carbon monoxide poisoning has been reported in India during winter season mostly due to incomplete burning of coal in locally available coal ovens.[9] Literature on Gas Geyser as a potential source of domestic fatality is very limited. With regard to fatal carbon monoxide poisoning associated with gas geysers, we could only identify a single report by Venkata Raghava and Devadass.[10] Another couple of cases of survived carbon monoxide poisoning from gas geysers have been reported in India.[11,12] We report a case of a 21-year-old previously healthy female who was found dead in the bathroom of her home; where a liquid petroleum gas (LPG) fitted water heater was used for boiling water.

2. Case report

A 21-year-old, previously healthy female had gone to take bath in her bathroom in the morning hours. When she did not come out of the bathroom for half an hour parents became anxious. They

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broke open the bathroom door when she did not respond to their calls, to find her lying unconscious on the floor. She was rushed to Kasturba Hospital; Manipal where she was declared brought dead.

A medicolegal autopsy was performed on the same day. On external examination; face appeared congested, rigor was established allover, cherry pink colored hypostasis was present over the back and dependent parts of the body (Fig. 1). Internal examination revealed cherry red discoloration of blood and tissues (Fig. 2); internal organs were congested with obvious pulmonary and cerebral edema. The blood samples were collected for quantitative estimation of carboxy hemoglobin (COHb). Presence of COHb was confirmed by spectrophotometer and compared with control blood sample (Fig. 3). A UV visible spectrophotometric measurement of the blood was performed at the Forensic Science Laboratory that reported dangerous levels (41.64%) of COHb. Otherwise toxicological analysis was negative for drugs and poisons. The death was attributed to an accidental carbon monoxide poisoning.

Investigation of the family members revealed that an LPG run gas geyser was recently installed in the bathroom. Scene was visited by a team of Forensic experts and investigating police officer. Bathroom measured 7 × 5 feet in size and was poorly ventilated (Fig. 4). Door and window were closed when the body was discovered. On enquiry into the past history of the victim, it was discovered that the deceased had complained of dizziness while taking bath a month back and had consulted a family physician for the same. She was treated for anaemia and weakness considering her menstrual age.

3. Discussion

Carbon monoxide has 200–250 times greater affinity for hemoglobin than oxygen.[13] Fatal outcome secondary to the exposure of carbon monoxide in high concentrations is generally due to formation of carboxy hemoglobin (COHb) which impairs the oxygen carrying capacity of the blood.[14] Other possible mechanism of toxicity include; alteration in dissociation characteristic of oxyHb, further decreasing oxygen delivery to tissues, decrease in cellular respiration by binding with cytochromes and metalloenzymes and binding to myoglobin causing myocardial and skeletal muscle dysfunction resulting in impaired tissue perfusion.[15] The clinical presentation of carbon monoxide poisoning is non-specific and may vary from nausea, headache, dizziness, confusion to profound central nervous system dysfunction and even death. Isolated non-specific symptoms such as fatigue or headache make the diagnosis difficult, as mentioned in the reported case where the victim was treated for anaemia and weakness.

Fig. 1. Cherry pink hypostasis on the back and dependent parts of the victim. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 2. Cut section of lungs and kidneys showing cherry red discolouration. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The autopsy diagnosis of fatal carbon monoxide poisoning is usually based on circumstantial evidence, autopsy findings and forensic blood investigations. Visit to scene of death indicated ill ventilated bathroom without proper exhausts. The bathroom door was bolted from inside, there was no outlet for combustion gases except for a small window that was closed at the time of the incident. Therefore because of passive ventilation and decreased oxygen victim suffered from hypoxia, collapsed and died. Though all the family members used to take bath in the same bathroom, only the deceased girl had the habit of taking long head showers. The duration of bath and closure of the window was detrimental for the young girl, leading to accumulation of fatal levels of carbon monoxide inside the bathroom.

The cherry pink/red colour of hypostasis, tissues and organs was suggestive of carbon monoxide poisoning. Cherry red colour is seen after excessive exposure and may represent a combination of carbon monoxide induced vasodilatation with concomitant tissue ischemia.[16] Forensic Science Laboratory reported fatal/dangerous levels of COHb in the blood of the victim (41.64%) by UV visible spectrophotometry. The normal levels of COHb are less than 2% in non-smokers and less than 5% in smokers. Heavy smoking can cause levels as high as 10–15%.[17,18] The COHb levels below 10% are usually not associated with any symptoms.[17] Headache, nausea, dizziness and confusion may develop with levels of 10–30%. Patient may develop coma and seizures at levels

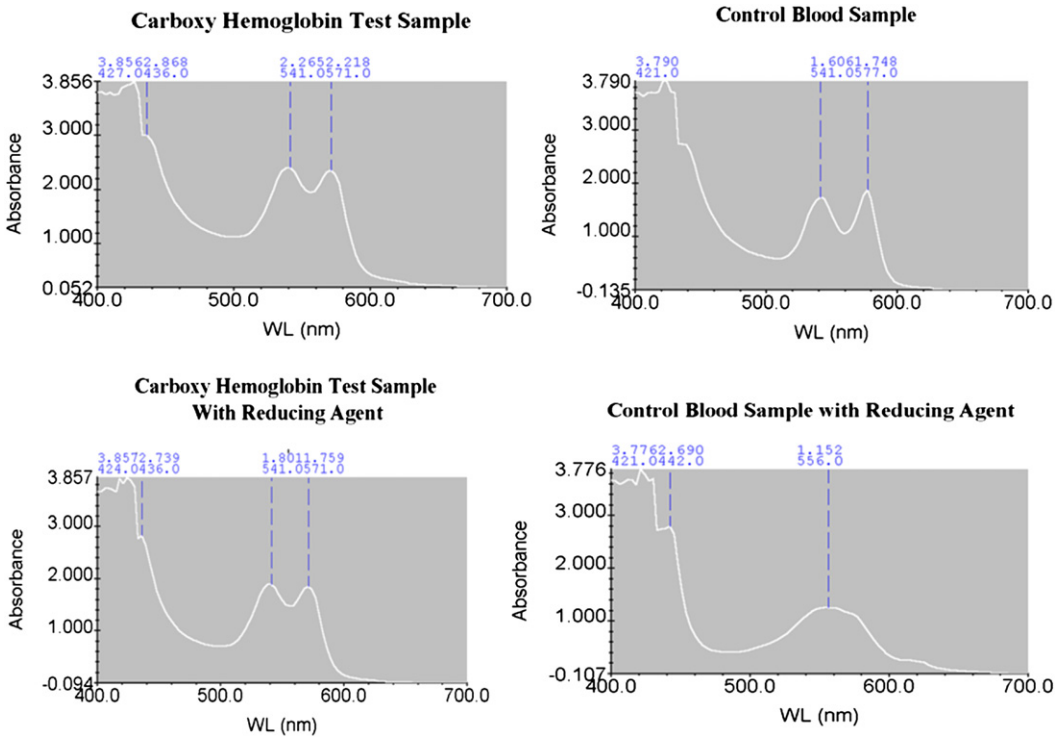

Fig. 3. Carboxy-haemoglobin levels in the blood with and without reducing agent.

30–50%. At COHb levels higher than 50% death may occur.[15,19–21] The central nervous system and heart are the most sensitive organs to CO poisoning. Headache, dizziness, and ataxia usually occur at COHb levels as low as 15–20%, with longer exposures, syncope, seizures, or coma can result. Myocardial infarction, life-threatening dysrhythmias, and cardiac arrest are commonly described in victims of carbon monoxide poisoning. Acute mortality in carbon monoxide poisoning is usually is due to ventricular dysrhythmias, probably caused by the accompanying hypoxia.[22,23]

Carbon monoxide is responsible for increasing number of accidental domestic poisoning especially at home with faulty or poorly ventilated combustible appliances common sites being the kitchen and bathroom. Gas geysers are cost-effective and less cumbersome to use and thus, are becoming a popular mode of heating water especially in suburban areas of our country. Incidents of accidental carbon monoxide poisoning in the bathroom are likely to rise owing to increase in use of gas water heater unless effective preventive measures are taken up. High index of suspicion is required among the clinicians for its diagnosis in suspected cases. A history of potential exposure is the most reliable indicator of carbon monoxide poisoning.[15]

Domestic carbon monoxide poisoning is rarely reported in India and remains an under recognized problem. Effective preventive measures can help in bringing down the mortality and morbidity associated with carbon monoxide poisoning. Development of carbon monoxide detector is potentially the most important advance in the prevention of carbon monoxide poisoning. This however should be considered a secondary prevention method and more cost-effective measures needs to be taken up in developing countries like India. It is suggested that cross ventilation be ensured in order to prevent such mishaps in future when any combustible device (like gas geyser) is used in a closed environment along with emphasis on the need for a regular maintenance of any fuel burning appliances.

Fig. 4. Scene of death: Bathroom with a gas geyser.

Immediate medical help should be sought if poisoning symptoms are suspected and a high index of suspicion on clinicians' part remains vital. With increasing use of gas water heater, public education about the dangers of carbon monoxide with emphasis on safety measures at home remains the key to effective prevention.

Conflict of interest

The authors have no conflict of interest to declare.

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Ethical approval

None declared.

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